

Local Area Networks

(March 2, 2016)

Learning Objectives

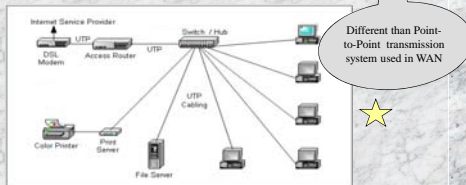
2

- Understand LAN Servers functions
- Understand common LAN standards

LAN: Definition

3

- A communication network that **interconnects networking devices** within a **small geographical area** using **broadcast system**.
- Networking devices include: Computers, Printers, Print Server devices, File Servers, Modems, etc.



Q: How many ports for the switch / hub?

Servers 4

- Common services:
 - File Service
 - Internet web service
 - Email service
 - File transfer service
 - Print service
 - Special network services
 - Autoconfiguration service
 - Domain name service
 - Remote Access Service
 - Internet Connection sharing


Selecting a server 5

- Single server Versus Multiple specialized Servers
Decision based on Cost, Optimization, Reliability, and Security



Single Multifunction Server

Costs less for small organizations



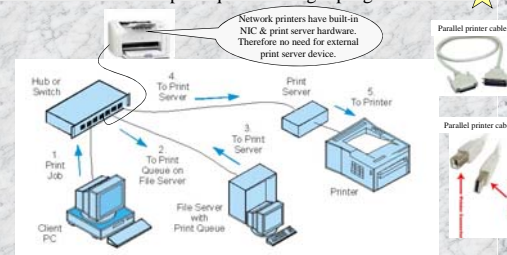
Multiple Specialized Servers

Optimized for performance needs of each service
Reliable: others continue if one crashes
Security: more difficult to access inappropriate servers

- Optimization:
 - File servers need storage capacity and rapid access
 - Client/Server applications need very fast processors

Print Service 6

- A **Print Server** device is basically: NIC + a parallel or USB port + Random Access Memory + Intelligence to receive data and commands from print queue manager program.



- **Note:** Possible to connect printer directly to file server, but people might have to walk far to get their printout.

LAN MAC protocols

7

Rule for effective communication

- All networking devices must use same MAC protocol: All Ethernet hubs/switches and Ethernet NICs OR All Token Ring MAUs and Token Ring NICs
- Communications cannot take place if different MAC protocols are being used.

Two major types of LAN

- **Token Ring**
 For LANs that use physical star topology (with MAU) and logical ring topology
 Offered at speeds of 4 and 16 Mbps.
 More expensive components than CSMA/CD
 Losing ground quickly to CSMA/CD
- **Ethernet or CSMA/CD**
 Most common form of LAN today.
 Star-wired bus topology using hub/switch is most common
 Many standards (from 10Base2 to Gigabit Ethernet)

Ethernet (IEEE 802.3) standards

8

<http://grouper.ieee.org/groups/802/index.html>
<http://standards.ieee.org/getieee802/802.3.html>

Ethernet standards

9

Table 7-2
summary of Ethernet standards

Ethernet Standard	Maximum Transmission Speed	Signal Type	Cable Type	Maximum Segment Length
10Base5	10 Mbps	Baseband	Coaxial	500 meters
10Base2	10 Mbps	Baseband	Coaxial	200 meters
1Base8	1 Mbps	Baseband	Unshielded twisted pair	800 meters
10BaseT	10 Mbps	Baseband	Unshielded twisted pair	100 meters
10Broad36	10 Mbps	Broadband	Coaxial	3600 meters
100BaseTX	100 Mbps	Baseband	2-pair Category 5 or higher unshielded twisted pair	100 meters
100BaseT4	100 Mbps	Baseband	4-pair Category 3 or higher unshielded twisted pair	100 meters
100BaseFX	100 Mbps	Baseband	Fiber optic	1000 meters
1000BaseSX	1000 Mbps	Baseband	Fiber optic	100 meters
1000BaseLX	1000 Mbps	Baseband	Fiber optic	100 meters
1000BaseCX	1000 Mbps	Baseband	Specialized balanced copper	25 meters
1000BaseT	1000 Mbps	Baseband	Twisted pair—four pairs	100 meter
10GBase-fiber	10 Gbps	Baseband	Fiber optic	—
10GBase-T	10 Gbps	Baseband	Cat 6/e	~100 meters
10GBase-CX	10 Gbps	Baseband	Twin axial	~30 meters

Rules for effective communications

- All networking devices must use same MAC protocol: All Ethernet hubs/switches and Ethernet NICs OR All Token Ring MAUs and Token Ring NICs
- Devices should operate at same speed. Example 10BaseT NIC and 10BaseT hub.
- NICs, Central collection points (hub, switch, MAU), and other internetworking devices should be compatible with the transmission media used.

O: If a LAN is described as 10BaseT, list everything you know about that network. ★

10Base2 and 10Base5 Ethernet 10

10Base5

Speed: ← 10 Mbps

Signal type: Baseband transmission

→ Distance: 500 meters

10Base2

Speed: ← 10 Mbps

Signal type: Baseband transmission

→ Distance: 185 meters

10Base2

- Speed: 10 Mbps
- Signal type: Baseband w coaxial cable
- Distance: 185 meters/segment
- Physical bus topology & logical bus topology
- No more than 30 nodes (computers, printers, etc.) per segment
- Nodes must be spaced at least 0.5 meters apart

10Base5

- Speed: 10 Mbps
- Signal type: Baseband w coax. cable
- Distance: 500 meters/segment
- Physical bus topology & logical bus topology
- No more than 100 nodes per segment
- Nodes must be spaced at least 2.5 meters intervals

10BaseT Ethernet 11

10BaseT

Speed: ← 10 Mbps

Signal type: Baseband transmission

→ Medium: Twisted pair

- Speed: 10 Mbps
- Signal type: Baseband
- Distance: 100 meters between the Hub/Switch and the node
- No more than 1024 nodes per Hub/Switch
- Physical star topology, logical bus topology
- Uses **2-pair of wire** CAT3 UTP with RJ-45 connectors

100BaseTX Ethernet 12

100BaseTX

Speed: ← 100 Mbps

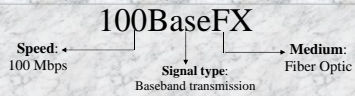
Signal type: Baseband transmission

→ Medium: Twisted pair

- Speed: 100 Mbps
- Signal type: Baseband
- Distance: 100 meters between the Hub/Switch and the node
- Topology: Physical star, logical bus using 100BaseTX collection points
- Uses two-pair CAT5 or better UTP with RJ-45 connectors

100BaseFX Ethernet

13



- Speed: 100 Mbps
- Signal type: Baseband
- Distance: Up to 2 kilometers between sender & receiver
- Topology: Physical star, logical bus using 100BaseFX collection points
- Uses multi-mode long wavelength fiber optics with lasers as light sources

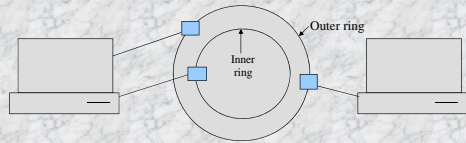
100BaseSX same as 100BaseFX, but uses less expensive short wavelength fiber optics with light-emitting diode (LED) and is limited to 300 m distance

LAN systems and standards

14

FDDI (Fiber Distributed Data Interface)

- Uses Token passing method
- Designed for transmission at 100 Mbps using Optical fiber
- Possible interconnection of 500 stations
- Allows for two concentric rings
 - The primary ring offers 100 Mbps data rate
 - Secondary ring for backup or for additional 100 Mbps data rate



Summary Questions

15

- 1) What are the four factors to take into account in deciding how many servers to use to implement a LAN's services?

Answer: Optimization, reliability, security, cost

- 2) To what two devices does a print server device connect?

Answer: To a printer via a parallel or USB cable and to a hub/switch via conducted media like UTP

- 3) In print service using a print server device, where does a print job go when it leaves the client PC (not counting the hub or switch)?

Answer: The print job first goes to a file server, which puts it in a print queue.

- 4) Do you have to use special printers for print service?

Answer: You do not need special printers, because any printer with a parallel or USB cable could be connected to the network using a print server device. Network printers come with integrated NIC. They can be used without a print server device.

Summary Questions

16

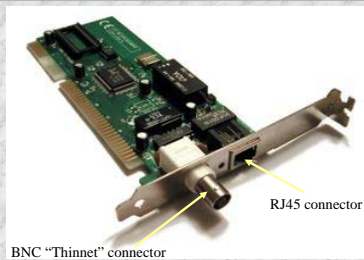
Your organization has 12 employees, each with his or her own stand-alone PC running Windows XP. Each computer has a 10 Mbps NIC that could work with coaxial cable or twisted pair (see next slide)

a) List *all* the additional hardware you would have to buy in order to install a 100BaseTX LAN. Make very sure that you list all the things the organization will have to buy. The organization wishes to provide [Internet] email service, file service, and print sharing with four existing printers fed with parallel ports.

b) How many ports should the hub or switch have? Explain.

Dual-transmission NIC

17



BNC "Thinner" connector

RJ45 connector

Ethernet standards

18

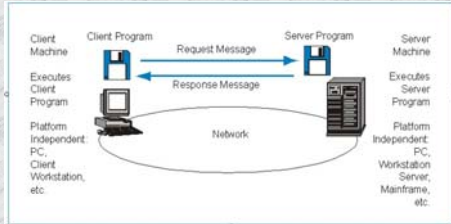
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Client/Server application Servers

19

- Servers used for Client/Server applications need very fast processors



File Servers

20

- *File Servers* need a great deal of very rapid disk storage

Program files and Data files are *stored* on a file server before execution



Client PC



Stored on the File Server



File Server

File Servers

21

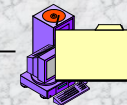
- For execution,  Program and data files are *downloaded* (copied) to the Client PC
-  Processing on the client PC, **not on the file server**
- File server merely *stores* programs and data files



Client PC



Downloaded to Client PC, Executed There



File Server

Disk fault tolerance

22

Server's capability to continue functioning in case of disk failure

Fault tolerance achieved through disk redundancy

Disk redundancy can be accomplished:

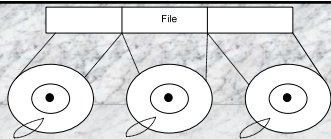
- by installing backup disk
- by installing RAID (Redundant Array of Independent Disks) drives

RAID's basic idea is

- To mirror a disk (i.e. to have a disk and its identical image) or
- To spread (or strip) data across many disks

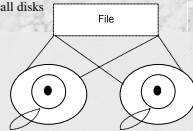
RAID

23



- Strips data across multiple disk
- No redundancy
- Advantage: Fast data access through multiple reads
- Disadvantage: Losing one disk results in losing data on all disks

RAID 1



- Doesn't strip data across many disk
- Mirrors data between two disks
- Data kept synchronized between two disks
- Advantage: Fault-tolerance, i.e. If one disk fails, the other continue working until failed disk is replaced
- Disadvantage: Only half of available storage space is used.

RAID

24



- Spreads data across multiple disks. Uses ECC bits for recovery purpose in case of problem
- ECC bits determined based on data stored on data disks
- If one data disk fails, disk controller automatically regenerates missing data

* Error Checking and Correcting
